Chemical Bonding and Reactions

PS-4 The student will demonstrate an understanding of chemical reactions and the classifications, structures, and properties of chemical compounds.

PS-4.6 Distinguish between chemical changes (including the formation of gas or reactivity with acids) and physical changes (including changes in size, shape, color, and/or phase).

Taxonomy Level: 4.1 B Analyze Conceptual Knowledge

Key Concepts:
Chemical change: gas formation, reaction with acids, tarnish
Physical change: phase change, expand/contract

Previous/Future knowledge: In the 7th grade students compared physical properties of matter (including melting or boiling point, density, and color) to the chemical property of reactivity with a certain substance (including the ability to burn or to rust) (7-5.9); and compared physical changes (including changes in size, shape, and state) to chemical changes that are the result of chemical reactions (including changes in color or temperature and formation of a precipitate or gas) (7-5.10). The 7th grade students were also introduced to acids (7-5.6).
In Physical Science the students will expand the concept for evidences of chemical changes that include the formation of a gas and reactivity with acids. They will expand their concept for evidences of physical changes to include changes in phase, size, shape, and color. Students will look at these evidences and determine the relevance of the evidence to distinguish changes that are physical from those that are chemical.

It is essential for students to understand
Chemical Changes

- A *chemical change* occurs when there is a change in the arrangement of the atoms involved so a different substance with different properties is produced. When a chemical reaction takes place some type of evidence can be observed.
  - One type of evidence might the formation of a new gas. This gas is not a phase change but is a new molecule formed by a chemical reaction. An example of this type of reaction would be the reaction of baking soda with vinegar. Carbon dioxide gas is formed which is evidence that a chemical reaction has occurred. The atoms are rearranged and a new substance (carbon dioxide) is formed.
- The reaction of a substance with an acid is another chemical change
  - Active metals react with acids. The metal will replace the hydrogen in the acid and form a salt and hydrogen gas. The atoms are rearranged and new substances are formed with different properties so this is a chemical change.
  - Acids react with bases to form water and a salt (neutralization reaction). The atoms are rearranged and new substances are formed with different properties so this is a chemical change.
- Color change may be evidence that chemical change has occurred.
  - Metal tarnishing and changing color is a chemical change because in this case atoms are rearranged and a new substance is formed.
  - The tarnish is a compound formed when the metal and another substance (such as oxygen or sulfur) combine.

Physical Changes

- A *physical change* is a change in matter from one form or appearance to another but does not involve a change in the identity of a substance.
- When physical changes occur a new substance is not produced.
  - A substance may change size, such as being broken into smaller pieces,
  - A substance may change in shape, such as being bent or stretched,
  - A substance may expand or contract due to a temperature change.
- Color change may indicate a physical change.
  - When different colors of paint, crayon, or food coloring are mixed together a mixture is formed and the color changes. No rearrangement of the atoms occurs. You still have the same substances that you started with they are just mixed together. This is a physical change.
- Phase changes (freezing, melting, evaporation, sublimation, etc.) are physical changes.

It is not essential for students to write chemical equations to show that chemical changes (reactions) have occurred.

Assessment Guidelines:
The objective of this indicator is to *distinguish* chemical changes, like gas formation or reactivity with acids, from physical changes, such as change in size, shape, color, or phase, therefore, the primary focus of assessment should be to differentiate among the criteria for physical change and chemical change. Assessments may require that students be able to determine the reason a change is chemical or physical.

In addition to *distinguish*, assessments may require that students

- *Classify* these changes as chemical or physical changes;
- *Exemplify* chemical and physical changes;
- *Infer* from a description of a change whether it is a chemical change or not;
- *Compare* physical and chemical changes.